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Item 10 (b) of the provisional agenda*

NATURAL DISASTER REDUCTION: HAZARD RESISTANT STRUCTURES

Technical session

Addendum

Development of light-weight natural rubber-based bearings for earthquake protection of small buildings

Summary of the contribution by the Malaysia Rubber Producers Research Association

1. A project executed by the United Nations Industrial Development Organization and financed by the German Government was initiated in 1991 for a period of four years in order to develop and test a prototype base isolator for small-scale buildings. It is executed in cooperation with the International Rubber Development Board (IRDB), through which all rubber producing member countries participate. The coordination of the project, as well as most activities related to rubber technology, are entrusted to the Malaysian Rubber Research and Development Board which is cooperating closely with the Earthquake Engineering Research Center of University of California at Berkeley, United States of America. The Project has two basic objectives: (a) to devise a fully reliable but affordable device for earthquake protection of small and relatively low-cost buildings; and (b) to develop the technology for an advanced natural rubber-based product with an attractive market.

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2. To achieve this dual objective, the project has established a close cooperation among a number of institutions, each specialized in their field and responsible for essential components of the complex product development task. This involves, inter alia:

(a) Development of design methodology and design criteria for bearings for low load applications for which rubber-base isolation has not hitherto been applied;

(b) Preliminary design of bearings, including choice of reinforcement material, bonding adhesive and steel plate (especially end plate) dimensions;

(c) Systematic development of high damping natural rubber compounds and study of the effects of basic compounding ingredients on critical damping ratio, resistance to high amplitude fatigue, long-term durability and resistance to ageing;

(d) Comparative evaluation of various types of connection between bearing and structure including bolted, dowelled and recessed bearings;

(e) Trial mouldings of bearings and dynamic testing of prototype bearings under load to detect and correct deviations from rubber and overall design specifications;

(f) Design of experimental buildings to be constructed on prototype bearings and simulated and scaled down shaking-table tests of the completed base-isolated structure or parts thereof;

(g) Construction of demonstration buildings and performance evaluations of the rubber-base isolation system under real life conditions.

3. Two experimental buildings have been designed and are presently under construction, incorporating the base isolators developed by the project: the first at Pasir, Badak, Java, Indonesia (a four-floor concrete frame building with masonry infill); and the second at Shantou, Guangdon Province, China (an eight-floor concrete frame building with masonry infill). The prototype bearing developed for the two demonstration projects has the following specifications: 15 rubber layers, 14 reinforcing steel plates and two end plates, plate diameter 136 mm, total weight of rubber 1094 g, plate thickness 1.20 mm, endplate thickness 17.3 mm.

4. The presentation will describe the methodology of design and experimental work, including exemplary international cooperation, the performance characteristics of the prototype bearings, and the construction of the demonstration buildings of which the one in China will be described during a seminar held immediately prior to the Conference at Yokohama.